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AN UNEQUALED SCIENTIFIC EXPERIMENT IN SPACE

M. V. Keldysh

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A press conference devoted to the new and outstanding victory of the Soviet people in the conquest of space and a meeting with the pilots-cosmonauts P. I. Belyayev and A. A. Leonov, who were the first in history to carry out egress by man into outer space from the spaceship "Voskhod-2", was held on 26 March 1965 in the assembly hall of the Moscow State University imeni M. V. Lomonosov. We publish below with some deletions the speeches by the president of the Academy of Sciences USSR, Academician M. V. Keldysh and the pilots-cosmonauts P. I. Belyayev and A. A. Leonov and their replies to certain questions. The participants in the press conference were shown documentary film clips, photographed by a camera on board, showing the preparations by the cosmonauts for the blast off, the egress of A. A. Leonov from the ship and his return on board the "Voskhod-2," as well as the preparations by the cosmonauts for reentry. On the occasion of the outstanding achievement in the sphere of cosmonautics, the first egress by man into outer space, the Presidium of the Academy of Sciences USSR awarded P. I. Belyayev and A. A. Leonov the Gold Medals imeni K. E. Tsiolkovskiy, who was the founder of space flight.

IN THE NAME OF SCIENCE AND PROGRESS

Academician M. V. Keldysh

The Soviet people systematically and consistently implement the study and conquest of outer space. A leading cosmic industry, which permits Soviet scientists and engineers to solve the grandiose tasks of penetrating the depths of the universe, has been created in our country. The collectives of scientific-research institutes and of design bureaus work on the design of spaceships, apparatuses, various systems and designs and carry out calculations for space navigation.

From the first artificial earth satellite and the initial flights to the moon, prior to spaceships piloted by Soviet people, our science and technology has demonstrated to the entire world the heights reached by the Soviet people, lead by the great party of Lenin.

It was necessary to solve one of the most fundamental tasks, the egress by man from a spaceship directly into outer space. The solution of this problem opens up new and great possibilities for the execution of further flights by man to the moon and other heavenly bodies and for the establishment of inhabited interplanetary stations. This required the creation of a system for leaving the ship in outer space.

Now we all know that the flight with the egress of a cosmonaut from the "Voskhod-2" spaceship into outer space was crowned with complete success.

The realization of the experiment on man's egress into space is one of the most remarkable achievements on the road to the conquering of outer space. This event marks the beginning of a qualitatively new stage in the investigations of the universe. Now new, grandiose prospects are opening up for the placement of orbital stations, linking of spaceships in orbit and the conducting of research in astronomy and geophysics in outer space.

In the near future it will be possible to place a Cosmic Scientific-Research Institute, where scientists of the most varied specialties will be able to work, in orbit around the earth. The results acquired during the flight of the "Voskhod-2" spaceship are a most important step on the way to the realization of the flights to the moon and to other heavenly bodies. The flight of the "Voskhod-2" spaceship is the outstanding success of our scientists, designers, engineers, analysts and workers and the success of all the Soviet people.

The feat of the Soviet cosmonauts P. I. Belyayev and A. A. Leonov was carried out in the name of science and in the name of progress. The scientific and technical achievements reached as a result of it belong to all mankind.

The communist party, the Soviet government and all Soviet people value highly the achievements of Soviet scientists and engineers, and the cosmonauts P. I. Belyayev and A. A. Leonov were awarded the title of Hero of the Soviet Union and their busts, along with the busts of Yu. A. Gagarin and V. V. Tereshkova, will be placed in Moscow.

THE FLIGHT, ITS PREPARATION AND EXECUTION

P. I. Belyayev
Pilot-cosmonaut, Colonel and Commander of
the "Voskhod-2" Spaceship

On 18 March 1965, at 10 A.M. Moscow time, our country using a powerful booster rocket placed into an earth orbit the spaceship-satellite "Voskhod-2," for which I was appointed the commander and the co-pilot was Lt. Col. A. A. Leonov. Having flown, during the course of 26 hours, more than 17 orbits around the earth and having travelled a distance of over 720,000 kilometers, the two man "Voskhod-2" spaceship successfully landed on 19 March at 12:02 Moscow time in the area of the city of Perm'.

The flight of the "Voskhod-2" shows once more that the intelligence and knowledge of Soviet scientists, the genius of the designers, engineers and technicians, and the skillful hands of the workers are capable of creating first-rate spaceships and rocket boosters.

The problem called for an orbital flight with a duration of 24 hours by the artificial earth satellite and the realization of the experiment on egress from the ship into outer space in the process of the orbital flight. The conduct of scientific observations and investigations, including medical and biological experiments, the solution of the elements of navigation in outer space and the observation and study of the earth atmosphere were foreseen.

The flight of the "Voskhod-2" spaceship was preceeded by lengthy and painstaking training of the crew.

Insofar as the "Voskhod-2" differed from preceeding ships and the program had planned an experiment for man's egress into outer space, our training was considerably complicated. We were in close contact with the designers, who had designed the ship, and participated in the testing of the various systems on the ship. A great deal of training was carried out on the scientific ship. On this ship Aleksey Leonov and I decided how we would work together during the various stages of the flight prior to automation and particularly during his egress and return to the ship.

If I were to be asked whether it all had been easy or difficult, I would answer that it had not been easy!

The program has been 100 percent completed. We began the realization of the experiment for man's egress into outer space practically immediately after reaching orbit.

My friend, Aleksey Leonov, efficiently carried out all preparatory operations for egress into outer space and awaited my command with impatience. He wanted to jump into space even before the time scheduled in the program but I held him back. A program is a program, and I, as the commander of the crew, was responsible for its execution. Having convinced myself of the fact that all of the safety systems on Aleksey Leonov were functioning normally and that his pulse and breathing were normal, I gave the command for egress into outer space at the appointed time.

Leonov and I were in constant telephone communication and the devices which had been set up in the cabin of the ship permitted me to control the work of the independent safety system as well as to check on the pulse and breathing.

During the period of the egress and Leonov's space walk, the influence of the transfer of the mass on the behavior of the ship was observed. All Leonov had to do was to move from one side of the ship to the other and it would clearly respond to these movements. All shifting against the exterior of the ship and any jolts were picked up within the ship. Thus, in addition to all of the envisaged systems of control over the cosmonaut who was in outer space there appeared an additional sound control "system."

During the course of the entire flight all systems and equipment on board the "Voskhod-2" ship functioned normally. The cabin temperature was approximately +18°C, the humidity was 35-40 percent and the pressure equaled one atmosphere. In order to carry out various scientific experiments and observations comfortably we removed portions of the space suit and in particular removed the helmet, boots and gloves, and I must say that we felt very good.

In accordance with the flight program we were to land during the 17th orbit by the automatic reentry process utilizing the solar orientation system. It must be noted that all previous manned space ships landed by using precisely this method. In case of a breakdown in the operation of the automatic landing system the cosmonauts always had the opportunity of landing by using the manual landing process, utilizing the duplication orientation system. Our cosmonauts have for a long time desired to utilize the manual landing system, thoroughly working it out on earth in their training, and were prepared to put it to use in flight. We also prepared for this. I will admit that we, pilots-cosmonauts, secretly were even angry at the automatic devices which deprived us of the opportunity of executing that which we wanted to do on our own. It, as if on purpose, always functioned without failure.

When, during the process of preparing to land, using the automatic landing cycle, we noticed certain irregularities in the functioning of the solar orientation system, this even made us happy. After all, we were now faced with an opportunity to land manually and in this way to open up one more remarkable capability of the Soviet piloted, now already in the full sense of that word, spaceships. Speaking frankly, we were only afraid of one thing, that we would not be permitted to do this. After all, it was possible to use the automatic system in the following orbit.

The approximately 30 seconds which were required to adopt a decision on our report and request for permission for the execution of a manual landing lasted a very long time for us. Finally, we were

given the go ahead for a manual landing on the 18th orbit. The earth was confident in our skill and had no doubt that we would be able to carry out the task.

The manual landing system functioned faultlessly and we landed approximately in the area specified, although with a slight overshot as a result of the novelty of such a landing. This is one more convincing proof of the many possibilities of our cosmic technology, insured against all accidents and the unexpected.

My qualities as a fighter pilot helped me successfully to land the "Voskhod-2" spaceship. During the time that I controlled the ship, I felt it as a pilot feels an airplane. The manual landing system for the spaceship is reliable and can be successfully applied in subsequent flights.

The landing was implemented with the utilization of the soft landing system which had already been used on the "Voskhod" spaceship. This system functioned faultlessly and fully justified its use.

The day that we returned to Moscow the United States placed in an earth orbit a "Gemini" spacecraft piloted by astronauts Grissom and Young. This is a national achievement by the USA. We greet and congratulate the courageous American astronauts.

Let the flights of our and the American cosmonauts be directed toward the exploration of the secrets of the universe in the interests of science and for the good of all mankind.

INTO OUTER SPACE

A. A. Leonov
Pilot-cosmonaut, Lt. Col., co-pilot
of the "Voskhod-2" Spaceship

Prior to moving on to a summary of the substance, I consider it my duty to tell you about that portion of the training and the, that is to say, overture which proceded the flight.

The five steps into the void were proceeded by tremendous work. Models of the ship and the locked chamber were operated, and conditions of a deep vacuum were created in the tank for testing temperature and pressure-measuring equipment. Under these conditions we, dressed in our pressurized suits, mastered stage after stage and memorized the moves for the entire locking process. When under these conditions everything had been brought to a point where it became automatic, we moved on to exercises in a special aircraft laboratory which had been

adapted for this type of training for the creation of short periods of weightlessness.

We recognized that the experiment to be carried out for the first time in the history of mankind on the egress from the ship into the open outer space was complicated and required extremely thorough execution. Therefore, we attempted to carry out all operations on the egress strictly according to the schedule, observing precision and clarity in the actions.

We began preparations for the experiment immediately after reaching our orbit. Before entering the air lock and while located in the cabin of the ship, I put on, with the aid of the commander, the pack containing the life line and the self-contained oxygen system and attached them to myself. I tested the equipment, systems and apparatuses for the registration of the physiological conditions which had to be measured during the walk in space and the registration of the variables in the spacesuit. We equalized the pressure in the chamber and in the cabin. Then we opened the hatch from the ship's cabin into the locked chaber and I swam through the hatch into the chamber. I pressurized the suit, checked that it was hermetically sealed, checked that the helmet was secured and checked the position of the light filter on it. Having checked the flow of oxygen into the suit and once more mentally going over the entire operation for the egress, I prepared myself to go out into outer space.

Pavel Ivanovich closed the hatch into the cabin of the ship. Having depressurized the chamber, the commander opened the hatch to the air-lock. The blinding beam of sunlight filled the chamber. The path into the cosmic abyss is open! I could hardly wait to look out sooner. I asked the commander but everything must go according to plan; it is not necessary to hurry. I waited a little longer. Finally, everything is ready and I may go. My head appeared beyond the opening of the exit hatch.

Boundless space appeared before me in all of its indescribable beauty. I had my first look at earth. It floated majestically before my eyes. The earth appeared flat. Only the curvature along the edges served as a reminder that it still was a globe. Despite the sufficiently dense light filter I saw vivid clouds, the azure of the Black Sea, the edge of the shore, the Caucasus Mountains and Novorossiysk Bay. The time came to leave the ship and enter space. (For clarity A. A. Leonov has drawn a diagram of the exit from the ship and explained it). Slowly, I make my way out of the chamber and then, gently pushing myself off from the hatch, I move away from the ship. I move further and further away from it. The umbilical cord by which I am connected to the ship has stretched out to its full length and my movement away from the ship stops. The slight effort while pushing away from the ship led to an insignificant angular shift of the ship and our wonderful space

apparatus began slowly to turn before my eyes. I expected to see sharp contrast between the light and the shadow but nothing of the sort occurred. The portions of the ship which were in the shade were lighted sufficiently well by the rays of the sun reflected from the earth. I pulled the umbilical cord a little bit toward myself and slowly began to approach the side of the ship. Then, I again pushed off from the ship and, turning around the lateral axis, began slowly to move away from the ship. The grandeur of cosmic space appeared before my eyes. The bright, nonflickering stars against the background of dark violet, changing into the velvety blackness of the bottomless sky, gave place to a view of the earth. The majestic green massifs passed before me, I recognized the Volga and the Mountain Range of the aging Ural and then I saw the Ob' and the Yenisey; it was as if I were floating above a huge colored map. The distance did not permit me to locate cities and the relief lines, but the person who is familar with a brush and an easel would have a hard time finding a more grandiose picture than the one which appeared before me. The bright sun, as if hammered into the blackness of the sky, with its rays penetrating through the visor of the helmet warmed my face noticeably. This was again followed by stars and by land areas on earth.

After some time I fairly energetically pulled myself, taking hold of the umbilical cord, and was forced to defend myself with my hands against the ship which began to approach me rapidly. At first I thought of how not to strike the ship with the side light on my helmet. However, when I approached the lock, I absorbed the shock with my hands. This appeared to be very easy to do, and I convinced myself of the fact that, having become accustomed to this, it is possible fairly accurately to move in a coordinated manner under these unusual conditions. My state of health was excellent and my mood was cheerful, I did not want to part with the free outer space and, even after I received the command to return to the ship, I once more shoved away from the hatch in order to verify what caused the angular velocity during the initial moment following the push off. This showed that the slightest shift in the direction of the force of the kick led to a rotation in the corresponding plane. Apparently, the people who will work in outer space still have to do a great deal of work on the immobilization of a body under conditions of weightlessness. As far as the so-called psychological barrier, which is supposed to be an insurmountable obstacle for man who is supposed to fact the cosmic abyss, is concerned, I did not experience any barrier and even forgot that it could exist at all. There was no time to think of it. Nevertheless, the 20 minutes that I spend under conditions of outer space, including the 10 minutes outside of the ship, were the height of the flight on the "Voskhod-2" ship. I knew this and, therefore, did everything necessary so that not one second would be uselessly lost.

In addition to that an extremely essential role was played by the fact that I maintained continuous communications with the commander

of the ship, my good friend, as well as with earth. I did not feel that I was alone in outer space. Finally, I had no doubts about the high quality of the space suit, the reliability of the equipment and the life-giving system. All of this imbued me with confidence in the successful execution of the experiment. Unfortunately, the time passed very quickly and the last moments of my sojourn in outer space arrived. I took off my movie camera which had recorded on film my entry into space and immediately attempted to enter the chamber, but this turned out not to be such an easy matter. After all, movements in the inflated space suit are somewhat limited. Fairly substantial physical effort was required and my parting with outer space was somewhat extended. Finally, I once again was inside the chamber, and, after some time, I was in the cabin next to Pavel Ivanovich, who congratulated me on the successful completion of the program of egress from the ship.

Finally, I should like to say a few words about those unforgetable impressions and about that gamut of colors which I was so fortunate to observe.

First of all, let me speak of the colors on the border between outer space and the earth. This border is easily distinguishable. Two spectra could be discerned: the spectrum from the portion of the earth in shade toward the lit portion and the spectrum from the illuminated portion of the earth to the dark. From the illuminated to the dark portion the change was from white through blue and dark blue into violet. In moving from the dark to the illuminated part, to this cold portion of the spectrum warm tones, red and yellow, were added.

Once I observed the following picture. It was 2:37 A.M. We saw the dark earth. Above it was a bright red band and then a pale yellow color. According to angular values, these bands appear to be equal to the sun which appeared to be somewhat distorted. During that time the stars appeared to us as if made of pure gold -- bright red.

In addition to the experiment on the walk in space we also conducted a number of scientific, medical and biological and technical tests and investigations.

In conclusion I should like to say that the preliminary results of our space flight permit us to make certain conclusions. Egress from the ship into outer space is completely possible and at present is not something mysterious for man. Man in a special space suit with the corresponding independent life giving systems can not only exist in space but also execute specific, purposeful and coordinated operations. Work of a physical nature and scientific observations can be carried out in outer space.

The way to conquering outer space is not easy. I am confident, however, that Soviet science and technology and the genius of our people will penetrate more deeply into the secrets of the universe and utilize them for the well-being and happiness of mankind.

ANSWERS TO QUESTIONS

Answers by P. I. Belyayev

Question: Where is the capsule of the "Voskhod-2" located at present? When and how was it removed from the landing area?

Answer: The "Voskhod-2" spaceship is located at the cosmodrome. It was delivered from the landing area through the means and efforts of aviation.

Question: How long could a spaceship of the "Voskhod-2" type with a two man crew stay in an earth orbit?

Answer: Over a month.

Question: Do spaceships of the "Voskhod-2" type possess the ability to maneuver and change orbit as the "Polyet" ship?

Answer: Yes, however, in the given case maneuvering was not planned for in the flight program.

Question: What were the assignments of the medical and biological investigations for the present flight?

Answer: The feature of the medical and biological program of the "Voskhod-2" flight was the special study of the psycho-physiological features as well as the bio-mechanics of movement during the execution of operations linked with egress into outer space. Substantial attention was paid to the study of the problem of man's ability to work in outer space.

Question: It had been stated in the past that spaceships could be reused following a flight. Does this also apply to the "Voskhod-2" ship?

Answer: Yes, it applies in the full sense of the meaning.

Question: Did not the ship hit trees during the landing, and how greatly is it damaged as a result of the landing?

Answer: The landing was very soft and the ship was not damaged at all.

Question: Is the system for controlling the ship that is used on the "Voskhod-2" ship suitable in principle for moon flights, that is, for a soft landing on the moon?

Answer: The system of manual control with which the "Voskhod-2" is equipped is not envisaged for use during a soft landing on the moon.

Question: Is it possible to control spaceships directly prior to landing and is it possible to get around obstacles which may appear?

Answer: The "Voskhod-2" spaceship does not require this.

Question: How do you evaluate the importance of the Gemini flight? Do you think that the Americans will catch up with the Soviet achievements in the conquest of space?

Answer: We believe that the Americans have taken a new step in this program.

Question: Does a landing in the forests create a threat for the crew and the ship?

Answer: No, it does not. The ship was not damaged and can again be used for space flight.

Question: How did you spend your time after the landing and before your departure for Perm'?

Answer: We had a good time, established communications, built a fire, ate and calmly awaited to be picked up.

Answers by A. A. Leonov

Question: You are not only the first man to walk in space but also the first cosmonaut-artist. Tell us what is the color of outer space? Did you see a combination of colors in outer space that you would use on earth?

Answer: My drawings were published by the press for the first time in 1961. These were cosmic landscapes. For this purpose I used the stories told by my friends who had already flown and depicted outer space according to their descriptions. This time I looked for myself and decided that I had not erred.

Question: When you were outside of the ship, what did you bolt and unbolt and did you use a special instrument?

Answer: I did not utilize a special instrument although I could have. I dismantled a camera and before that took off the silencing device and placed it in a new orbit. Today, you will see a film and you will be able to evaluate it.

Question: Did you breathe through the umbilical cord or did part of the oxygen come from the tank on your back?

Answer: The entire walk was carried out with the independent system included in the pack.

Question: What means of communications were contained in the space suit?

Answer: Communications with the commander of the ship were maintained via telephone which was contained within the umbilical cord. In addition to that the commander of the ship has already noted that he heard the entire "row" that I created in outer space through the walls of the ship.

Question: In future flights will cosmonauts be able to move away to great distances from the ship using individual propellents such as jet power or gas pistols?

Answer: I think that they will.

Question: What would happen in the event that after you had left the ship you were to faint; are there automatic devices which would return you to "Voskhod-2" in such a case?

Answer: I believe that the commander of the ship could reach me at any time to help.

Question: Did your wife know beforehand that you were to emerge from the ship while in outer space?

Answer: Perhaps she had guessed this. However, she knew that I would return nevertheless.

Question: Before lift-off by "Voskhod-2" you jokingly said that you would be a high altitude fitter. Did a part of the research involve assembly work? The builders are interested whether construction and assembly specialties will be required in outer space?

Answer: I have already stated that I did certain assembly and disassembly work. As far as the builders are concerned, I think that they should start preparations now.

Question: The newspaper Daily Worker published the black and white drawing which you had prepared prior to the flight for the newspaper Komsomol'skaya Pravda (Komsomol Pravda). When will we be able to see your picture prepared following the flight?

Answer: I have just been informed that I have been accepted as a member of the Union of Soviet Artists. This is a very serious organization and it is said that they take a long time to create a painting.

Question: Did you take your space suit off after you returned to the cabin of the spaceship?

Answer: I did not take it off although I could have done so.

Answers by Academician M. V. Keldysh

The scientist is questioned as to his opinion concerning the material published in the American newspaper New York Herald Tribune which recently wrote that the space age was opened by the US Air Force that in 1952 shot a monkey to an altitude of 36 miles.

I do not know, states M. V. Keldysh, what altitude can be considered as the first step in outer space; however, I think that the Americans have achieved a sufficient number of serious things, and such arguments are not necessary to show that they have worked on space research.

Question: Will cosmonauts during future flights be able to transfer from one spaceship to another?

Answer: I believe that they will. Undoubtedly, the concluded experiment will be a great step in this direction.

Question: What problems of space flight have as yet to be resolved before large space stations can be assembled in orbit?

Answer: There are many problems but the chief of them is the rendezvous of several spaceships.

Question: What stages and what problems in space research are presented as the most important for the Soviet Union up to 1970?

Answer: It is difficult to ennumerate. However, the great problems in space research are the development of manned flights, the establishment of interplanetary stations, the reaching of other planets and the investigation of the physics and other properties of outer space.

Question: We are attending the sixth press conference with Soviet cosmonauts. May we hope that we will meet for a seventh during this year?

Answer: If it is pleasant to meet, then you can hope for this.

Question: When will Soviet cosmonauts be able to carry out maneuvers for the purpose of changing the orbit of the spaceships?

Answer: Comrade Belyayev already stated that the "Voskhod-2" ship could have executed certain maneuvers, and I should like to remind you that the first automatic ships capable of modifying their orbits were launched in the Soviet Union about a year and a half ago. This was "Polet-1." The, "Polet-2" was launched, also with the automatic capability of orbit modification. All of the systems on board were operational. We believe that we have all of the possibilities for maneuvering ships in orbit.